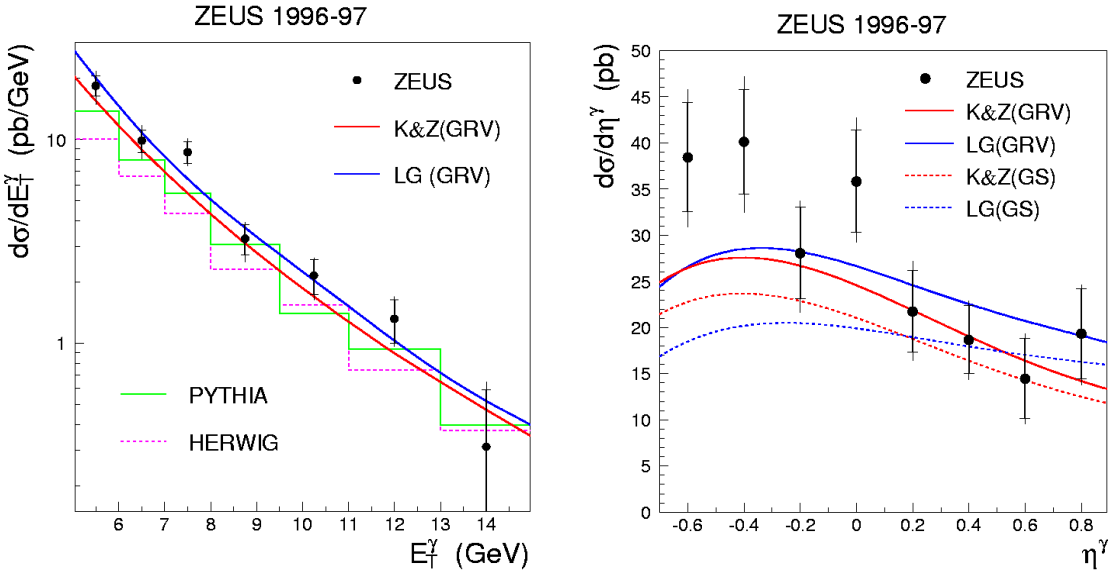
Measurement of inclusive prompt photon photoproduction at HERA

When electrons or positrons collide with protons at HERA, most of the interactions take place by the electron first radiating a photon which then interacts with the proton; in most cases the photons are similar to those of ordinary light, except that they are of very much higher energy. In this way, we can "look" at the structure of the proton using "very high energy light".

Sometimes the incoming photon can scatter off quarks inside the proton and re-emerge at a large angle, where it can be detected in the ZEUS experiment. Emerging photons such as this are termed *prompt* photons, and allow us to "see" quarks inside the proton. There are other possible reactions, however, which can also give rise to prompt photons, mainly when the incoming photon itself behaves as a source of quarks and gluons. When these scatter off the quarks and gluons in the proton, prompt photons can sometimes be produced. What we observe, finally, is the sum of all these possible processes.

The figures below show, on the left-hand side, the transverse component of the energy of the prompt photons observed by ZEUS. This is compared with various theoretical predictions. The right-hand figure shows the angular distribution of the prompt photons. The quantity η^{γ}, known as rapidity, is an angular measure which is zero when a particle emerges at 90 degrees in the laboratory, and takes values of ± 1 when the particle is seen at ± 45 degrees in the laboratory (positive is in the proton direction). The two figures show that the transverse energy is well predicted on average by most of the models, although HERWIG is a little low. However the observed angular distribution of the photons is higher than all the models in the negative η^{γ} (backward) region. This implies that the parton structure of the photon, as currently used in the theoretical models, needs to be re-assessed.



Differential cross section for prompt photon production as a function of transverse energy of the photon (left) and pseudorapidity (right). The cross sections are compared to PYTHIA and HERWIG using the next-to-leading-order calculations of Gordon (LG) and Krawczyk and Zembruski (ZG). The right-hand plot also shows the LG and ZG calculations with two different (higher order) photon parton distribution sets, one due to Gordon & Storrow and the other to Glück, Reya and Vogt.